This modern and self-contained book offers a clear and accessible introduction to the important topic of machine learning with neural networks. In addition to describing the mathematical principles of the topic, and its historical evolution, strong connections are drawn with underlying methods from statistical physics and current applications within science and engineering. Closely based around a well-established undergraduate course, this pedagogical text provides a solid understanding of the key aspects of modern machine learning with artificial neural networks, for students in physics, mathematics, and engineering. Numerous exercises expand and reinforce key concepts within the book and allow students to hone their programming skills. Frequent references to current research develop a detailed perspective on the state-of-the-art in machine learning research.

This accessible and engaging textbook presents a concise introduction to the exciting field of artificial intelligence (AI). The broad-ranging discussion covers the key subdisciplines within the field, describing practical algorithms and concrete applications in the areas of agents, logic, search, reasoning under uncertainty, machine learning, neural networks, and reinforcement learning. Fully revised and updated, this much-anticipated second edition also includes new material on deep learning. Topics and features:

- presents an application-focused and hands-on approach to learning, with supplementary teaching resources provided at an associated website;
- contains numerous study exercises and solutions, highlighted examples, definitions, theorems, and illustrative cartoons;
- includes chapters on predicate logic, PROLOG, heuristic search, probabilistic reasoning, machine learning and data mining, neural networks and reinforcement learning;
- reports on developments in deep learning, including applications of neural networks to generate creative content such as text, music and art (NEW);
- examines performance evaluation of clustering algorithms, and presents two practical examples explaining Bayes' theorem and its relevance in everyday life (NEW);
- discusses search algorithms, analyzing the cycle check, explaining route planning for car navigation systems, and introducing Monte Carlo Tree Search (NEW);
- includes a section in the introduction on AI and society, discussing the implications of AI on topics such as employment and transportation (NEW).

Ideal for foundation courses or modules on AI, this easy-to-read textbook offers an excellent overview of the field for students of computer science and other technical disciplines, requiring no more than a high-school level of knowledge of mathematics to understand the material.
Chapter six covers most of the major neural network paradigms, while associative memories and energy minimizing nets are given detailed coverage in the next approach. This organization of material makes it natural to switch into learning multilayer nets using backprop and its variants, described in chapter five. The convergence and solution properties of these learning rules are then treated mathematically in chapter four, using the "average learning equation" analysis architectures involved. Supervised, reinforcement, and unsupervised learning rules in simple nets are brought together in a common framework in chapter three.

The first two chapters present the basic building blocks and concepts of artificial neural networks and analyze the computational capabilities of the basic network will aid in the development of neural network analysis and design skills, and a bibliography of nearly 700 references. Proceeding in a clear and logical fashion, observations and commonly used heuristics. There are numerous illustrative examples, over 200 end-of-chapter analytical and computer-based problems that subject more accessible to students and practitioners. Here, important results are integrated in order to more fully explain a wide range of existing empirical employed by neural network researchers. Such a systematic and unified treatment, although sadly lacking in most recent texts on neural networks, makes the neural network paradigms by identifying clearly the fundamental concepts and major methodologies underlying most of the current theory and practice.
gradient search, simulated annealing, and genetic algorithms. This comprehensive tutorial on artificial neural networks covers all the important neural network architectures as well as the most recent theory—e.g., pattern recognition, statistical theory, and other mathematical prerequisites. A broad range of applications is provided for each of the architectures.

Though mathematical ideas underpin the study of neural networks, the author presents the fundamentals without the full mathematical apparatus. All aspects of the field are tackled, including artificial neurons as models of their real counterparts; the geometry of network action in pattern space; gradient descent methods, including back-propagation; associative memory and Hopfield nets; and self-organization and feature maps. The traditionally difficult topic of adaptive resonance theory is clarified within a hierarchical description of its operation. The book also includes several real-world examples to provide a concrete focus. This should enhance its appeal to those involved in the design, construction and management of networks in commercial environments and who wish to improve their understanding of network simulator packages. As a comprehensive and highly accessible introduction to one of the most important topics in cognitive and computer science, this volume should interest a wide range of readers, both students and professionals.

This book provides comprehensive coverage of neural networks, their evolution, their structure, the problems they can solve, and their applications. The first half of the book looks at theoretical investigations on artificial neural networks and addresses the key architectures that are capable of implementation in various application scenarios. The second half is designed specifically for the production of solutions using artificial neural networks to solve practical problems arising from different areas of knowledge. It also describes the various implementation details that were taken into account to achieve the reported results. These aspects contribute to the maturation and improvement of experimental techniques to specify the neural network architecture that is most appropriate for a particular application scope. The book is appropriate for students in graduate and upper undergraduate courses in addition to researchers and professionals.

Elements of Artificial Neural Networks provides a clearly organized general introduction, focusing on a broad range of algorithms, for students and others who want to use neural networks rather than simply study them. The authors, who have been developing and team teaching the material in a one-semester course over the past six years, describe most of the basic neural network models (with several detailed solved examples) and discuss the rationale and advantages of the models, as well as their limitations. The approach is practical and open-minded and requires very little mathematical or technical background. Written from a computer science and statistics point of view, the text stresses links to contiguous fields and can easily serve as a first course for students in economics and management. The opening chapter sets the stage, presenting the basic concepts in a clear and objective way and tackling important—yet rarely addressed—questions related to the use of neural networks in practical situations. Subsequent chapters on supervised learning (single layer and multilayer networks), unsupervised learning, and associative models are structured around classes of problems to which networks can be applied. Applications are discussed along with the algorithms. A separate chapter takes up optimization methods. The most frequently used algorithms, such as backpropagation, are introduced early on, right after perceptrons, so that these can form the basis for initiating course projects. Algorithms published as late as 1995 are also included. All of the algorithms are presented using block-structured pseudo-code, and exercises are provided throughout. Software implementing many commonly used neural network algorithms is available at the book’s website. Transparency masters, including abbreviated text and figures for the entire book, are available for instructors using the text.

Artificial Neural Systems or neural networks are physically cellular systems which can acquire, store and utilize experimental knowledge. It helps the reader to understand the acquisition and retrieval of experimental knowledge in densely interconnected networks containing cells of processing elements and
The idea of simulating the brain was the goal of many pioneering works in Artificial Intelligence. The brain has been seen as a neural network, or a set of nodes, connected by communication lines. Currently, there has been increasing interest in the use of neural network models. This book contains chapters on basic concepts of artificial neural networks, recent connectionist architectures and several successful applications in various fields of knowledge, from assisted speech therapy to remote sensing of hydrological parameters, from fabric defect classification to application in civil engineering. This is a current book on Artificial Neural Networks and Applications, bringing recent advances in the area to the reader interested in this always-evolving machine learning technique.

This book is an exploration of an artificial neural network. It has been created to suit even the complete beginners to artificial neural networks. The first part of
the book is an overview of artificial neural networks so as to help the reader understand what they are. You will also learn the relationship between the neurons which make up the human brain and the artificial neurons. Artificial neural networks embrace the concept of learning which is common in human beings. This book guides you to understand how learning takes place in artificial neural networks. The back-propagation algorithm, which is used for training artificial neural networks, is discussed. The book also guides you through the architecture of an artificial neural network. The various types of artificial neural networks based on their architecture are also discussed. The book guides you on the necessary steps for one to build a neural network. The perception, which is a type of an artificial neural network, is explored, and you will explore how to implement one programmatically. The following topics are discussed in this book:

- What is a Neural Network?
- Learning in Neural Networks
- The Architecture of Neural Networks
- Building Neural Networks
- The Perceptron

This book covers theoretical aspects as well as recent innovative applications of Artificial Neural Networks (ANNs) in natural, environmental, biological, social, industrial and automated systems. It presents recent results of ANNs in modelling small, large and complex systems under three categories, namely:

1) Networks, Structure Optimisation, Robustness and Stochasticity
2) Advances in Modelling Biological and Environmental Systems
3) Advances in Modelling Social and Economic Systems

The book aims at serving undergraduates, postgraduates and researchers in ANN computational modelling.

The two volume set LNCS 3696 and LNCS 3697 constitutes the refereed proceedings of the 15th International Conference on Artificial Neural Networks, ICANN 2005, held in Warsaw, Poland in September 2005. The over 600 papers submitted to ICANN 2005 were thoroughly reviewed and carefully selected for presentation. The first volume includes 106 contributions related to Biological Inspirations; topics addressed are modeling the brain and cognitive functions, development of cognitive powers in embodied systems, spiking neural networks, associative memory models, models of biological functions, projects in the area of neuroIT, evolutionary and other biological inspirations, self-organizing maps and their applications, computer vision, face recognition and detection, sound and speech recognition, bioinformatics, biomedical applications, and information-theoretic concepts in biomedical data analysis. The second volume contains 162 contributions related to Formal Models and their Applications and deals with new neural network models, supervised learning algorithms, ensemble-based learning, unsupervised learning, recurrent neural networks, reinforcement learning, bayesian approaches to learning, learning theory, artificial neural networks for system modeling, decision making, optimization and control, knowledge extraction from neural networks, temporal data analysis, prediction and forecasting, support vector machines and kernel-based methods, soft computing methods for data representation, analysis and processing, data fusion for industrial, medical and environmental applications, non-linear predictive models for speech processing, intelligent multimedia and semantics, applications to natural language processing, various applications, computational intelligence in games, and issues in hardware implementation.

An introduction to a broad range of topics in deep learning, covering mathematical and conceptual background, deep learning techniques used in industry, and research perspectives. "Written by three experts in the field, Deep Learning is the only comprehensive book on the subject." —Elon Musk, cochair of OpenAI; co-founder and CEO of Tesla and SpaceX

Deep learning is a form of machine learning that enables computers to learn from experience and understand the world in terms of a hierarchy of concepts. Because the computer gathers knowledge from experience, there is no need for a human computer operator to formally specify all the knowledge that the computer needs. The hierarchy of concepts allows the computer to learn complicated concepts by building them out of simpler ones; a graph of these hierarchies would be many layers deep. This book introduces a broad range of topics in deep learning. The text offers mathematical and conceptual background, covering relevant concepts in linear algebra, probability theory and information theory, numerical computation, and machine learning. It describes deep learning techniques used by practitioners in industry, including deep feedforward networks, regularization, optimization algorithms, convolutional networks, sequence modeling, and practical methodology; and it surveys such applications as natural language processing, speech recognition, computer vision, online recommendation systems, bioinformatics, and videogames. Finally, the book offers research perspectives, covering such theoretical topics as linear factor models, autoencoders, representation learning, structured probabilistic models, Monte Carlo methods, the partition function, approximate inference, and deep generative models. Deep Learning can be used by undergraduate or graduate students planning careers in either industry or research, and scientists and engineers working in fields in which deep learning methods can be applied.
The book is dedicated to intelligent systems of broad-spectrum application, such as personal and social biosafety or use of intelligent sensory micro-nanosystems such as “e-nose”, “e-tongue” and “e-eye”. In addition to that, effective acquiring information, knowledge management and improved knowledge transfer in any media, as well as modeling its information content using meta-and hyper heuristics and semantic reasoning all benefit from the systems covered in this book. Intelligent systems can also be applied in education and generating the intelligent distributed eLearning architecture, as well as in a large number of technical fields, such as industrial design, manufacturing and utilization, e.g., in precision agriculture, cartography, electric power distribution systems, intelligent building management systems, drilling operations etc. Furthermore, decision making using fuzzy logic models, computational recognition of comprehension uncertainty and the joint synthesis of goals and means of intelligent behavior biosystems, as well as diagnostic and human support in the healthcare environment have also been made easier.

Though mathematical ideas underpin the study of neural networks, the author presents the fundamentals without the full mathematical apparatus. All aspects of the field are tackled, including artificial neurons as models of their real counterparts; the geometry of network action in pattern space; gradient descent methods, including back-propagation; associative memory and Hopfield nets; and self-organization and feature maps. The traditionally difficult topic of adaptive resonance theory is clarified within a hierarchical description of its operation. The book also includes several real-world examples to provide a concrete focus. This should enhance its appeal to those involved in the design, construction and management of networks in commercial environments and who wish to improve their understanding of network simulator packages. As a comprehensive and highly accessible introduction to one of the most important topics in cognitive and computer science, this volume should interest a wide range of readers, both students and professionals, in cognitive science, psychology, computer science and electrical engineering.

This tutorial text provides the reader with an understanding of artificial neural networks (ANNs), and their application, beginning with the biological systems which inspired them, through the learning methods that have been developed, and the data collection processes, to the many ways ANNs are being used today. The material is presented with a minimum of math (although the mathematical details are included in the appendices for interested readers), and with a maximum of hands-on experience. All specialized terms are included in a glossary. The result is a highly readable text that will teach the engineer the guiding principles necessary to use and apply artificial neural networks.
Data assimilation is a process of fusing data with a model for the singular purpose of estimating unknown variables. It can be used, for example, to predict the evolution of the atmosphere at a given point and time. This book examines data assimilation methods including Kalman filtering, artificial intelligence, neural networks, machine learning, and cognitive computing.

Originating from models of biological neural systems, artificial neural networks (ANN) are the cornerstones of artificial intelligence research. Catalyzed by the upsurge in computational power and availability, and made widely accessible with the co-evolution of software, algorithms, and methodologies, artificial neural networks have had a profound impact in the elucidation of complex biological, chemical, and environmental processes. Artificial Neural Networks in Biological and Environmental Analysis provides an in-depth and timely perspective on the fundamental, technological, and applied aspects of computational neural networks. Presenting the basic principles of neural networks together with applications in the field, the book stimulates communication and partnership among scientists in fields as diverse as biology, chemistry, mathematics, medicine, and environmental science. This interdisciplinary discourse is essential not only for the success of independent and collaborative research and teaching programs, but also for the continued interest in the use of neural network tools in scientific inquiry. The book covers:

- A brief history of computational neural network models in relation to brain function
- Neural network operations, including neuron connectivity and layer arrangement
- Basic building blocks of model design, selection, and application from a statistical perspective
- Neurofuzzy systems, neuro-genetic systems, and neuro-fuzzy-genetic systems
- Function of neural networks in the study of complex natural processes

Scientists deal with very complicated systems, much of the inner workings of which are frequently unknown to researchers. Using only simple, linear mathematical methods, information that is needed to truly understand natural systems may be lost. The development of new algorithms to model such processes is needed, and ANNs can play a major role.

Balancing basic principles and diverse applications, this text introduces newcomers to the field and reviews recent developments of interest to active neural network practitioners.

This book presents carefully revised versions of tutorial lectures given during a School on Artificial Neural Networks for the industrial world held at the University of Limburg in Maastricht, Belgium. The major ANN architectures are discussed to show their powerful possibilities for empirical data analysis, particularly in situations where other methods seem to fail. Theoretical insight is offered by examining the underlying mathematical principles in a detailed, yet clear and illuminating way. Practical experience is provided by discussing several real-world applications in such areas as control, optimization, pattern recognition, software engineering, robotics, operations research, and CAM.

Neural networks are a computing paradigm that is finding increasing attention among computer scientists. In this book, theoretical laws and models previously scattered in the literature are brought together into a general theory of artificial neural nets. Always with a view to biology and starting with the simplest nets, it is shown how the properties of models change when more general computing elements and net topologies are introduced. Each chapter contains examples, numerous illustrations, and a bibliography. The book is aimed at readers who seek an overview of the field or who wish to deepen their knowledge. It is suitable as a basis for university courses in neurocomputing.

There is a deep desire in men, in order to reproduce intelligence and place it in a machine. Neural Networks are an attempt to reproduce the synaptic connections of our brain in a computer. Duplicating the way we use our neurons to think in a machine, it is expected to have a device that could be able to do "intelligent" tasks, the ones reserved just to humans some time ago. Neural Network are a reality now, not a fantasy, and they have been made in order to recognize patterns (a face, a photograph or a song, are patterns) and forecast trends. I have seen many books about this subject in my life. All of them are hard to read, and tedious to learn, so I decided to make my own one. For beginner readers, I have tried to use a simple language, in order to be understood by anyone who wants to know about nets. An easy to read, practical and concise work. If you are interested in the brain functions and how can we simulate it in a computer, you'll get here a different way to penetrate into their secrets. For advanced readers who want to make their own nets, I have included a methodology for building...
Introduction to Artificial Neural Networks and Deep Learning

The book should serve as a text for a university graduate course or for an advanced undergraduate course on neural networks in engineering and computer science departments. It should also serve as a self-study course for engineers and computer scientists in the industry. Covering major neural network approaches and architectures with the theories, this text presents detailed case studies for each of the approaches, accompanied with complete computer codes and the corresponding computed results. The case studies are designed to allow easy comparison of network performance to illustrate strengths and weaknesses of the different networks.

This book covers both classical and modern models in deep learning. The primary focus is on the theory and algorithms of deep learning. The theory and algorithms of neural networks are particularly important for understanding important concepts, so that one can understand the important design concepts of neural architectures in different applications. Why do neural networks work? When do they work better than off-the-shelf machine-learning models? When is depth useful? Why is training neural networks so hard? What are the pitfalls? The book is also rich in discussing different applications in order to give the practitioner a flavor of how neural architectures are designed for different types of problems. Applications associated with many different areas like recommender systems, machine translation, image captioning, image classification, reinforcement-learning based gaming, and text analytics are covered. The chapters of this book span three categories: The basics of neural networks: Many traditional machine learning models can be understood as special cases of neural networks. An emphasis is placed in the first two chapters on understanding the relationship between traditional machine learning and neural networks. Support vector machines, linear/logistic regression, singular value decomposition, matrix factorization, and recommender systems are shown to be special cases of neural networks. These methods are studied together with recent feature engineering methods like word2vec. Fundamentals of neural networks: A detailed discussion of training and regularization is provided in Chapters 3 and 4. Chapters 5 and 6 present radial-basis function (RBF) networks and restricted Boltzmann machines. Advanced topics in neural networks: Chapters 7 and 8 discuss recurrent neural networks and convolutional neural networks. Several advanced topics like deep reinforcement learning, neural Turing machines, Kohonen self-organizing maps, and generative adversarial networks are introduced in Chapters 9 and 10. The book is written for graduate students, researchers, and practitioners. Numerous exercises are available along with a solution manual to aid in classroom teaching. Where possible, an application-centric view is highlighted in order to provide an understanding of the practical uses of each class of techniques.

In this book, highly qualified multidisciplinary scientists grasp their recent researches motivated by the importance of artificial neural networks. It addresses advanced applications and innovative case studies for the next-generation optical networks based on modulation recognition using artificial neural networks, hardware ANN for gait generation of multi-legged robots, production of high-resolution soil property ANN maps, ANN and dynamic factor models to combine forecasts, ANN parameter recognition of engineering constants in Civil Engineering, ANN electricity consumption and generation forecasting, ANN for advanced process control, ANN breast cancer detection, ANN applications in biofuels, ANN modeling for manufacturing process optimization, spectral interference correction using a large-size spectrometer and ANN-based deep learning, solar radiation ANN prediction using NARX model, and ANN data assimilation for an atmospheric general circulation model.

An Introduction to Neural Networks falls into a new ecological niche for texts. Based on notes that have been class-tested for more than a decade, it is aimed at cognitive science and neuroscience students who need to understand brain function in terms of computational modeling, and at engineers who want to go beyond formal algorithms to applications and computing strategies. It is the only current text to approach networks from a broad neuroscience and cognitive science perspective, with an emphasis on the biology and psychology behind the assumptions of the models, as well as on what the models might be used for.
describes the mathematical and computational tools needed and provides an account of the author's own ideas. Students learn how to teach arithmetic to a neural network and get a short course on linear associative memory and adaptive maps. They are introduced to the author's brain-state-in-a-box (BSB) model and are provided with some of the neurobiological background necessary for a firm grasp of the general subject. The field now known as neural networks has split in recent years into two major groups, mirrored in the texts that are currently available: the engineers who are primarily interested in practical applications of the new adaptive, parallel computing technology, and the cognitive scientists and neuroscientists who are interested in scientific applications. As the gap between these two groups widens, Anderson notes that the academics have tended to drift off into irrelevant, often excessively abstract research while the engineers have lost contact with the source of ideas in the field. Neuroscience, he points out, provides a rich and valuable source of ideas about data representation and setting up the data representation is the major part of neural network programming. Both cognitive science and neuroscience give insights into how this can be done effectively: cognitive science suggests what to compute and neuroscience suggests how to compute it.

The book reports on the latest theories on artificial neural networks, with a special emphasis on bio-neuroinformatics methods. It includes twenty-three papers selected from among the best contributions on bio-neuroinformatics-related issues, which were presented at the International Conference on Artificial Neural Networks, held in Sofia, Bulgaria, on September 10-13, 2013 (ICANN 2013). The book covers a broad range of topics concerning the theory and applications of artificial neural networks, including recurrent neural networks, super-Turing computation and reservoir computing, double-layer vector perceptrons, nonnegative matrix factorization, bio-inspired models of cell communities, Gestalt laws, embodied theory of language understanding, saccadic gaze shifts and memory formation, and new training algorithms for Deep Boltzmann Machines, as well as dynamic neural networks and kernel machines. It also reports on new approaches to reinforcement learning, optimal control of discrete time-delay systems, new algorithms for prototype selection, and group structure discovering. Moreover, the book discusses one-class support vector machines for pattern recognition, handwritten digit recognition, time series forecasting and classification, and anomaly identification in data analytics and automated data analysis. By presenting the state-of-the-art and discussing the current challenges in the fields of artificial neural networks, bioinformatics and neuroinformatics, the book is intended to promote the implementation of new methods and improvement of existing ones, and to support advanced students, researchers and professionals in their daily efforts to identify, understand and solve a number of open questions in these fields.